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COASTAL STORM HAZARD REDUCTION THROUGH DEVELOPMENT MANAGEMENT: RESULTS OF A SURVEY OF HURRICANE-PRONE LOCALITIES

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I. Introduction

Very little data is available in the past on how coastal localities address the hurricane and severe storm threat. An important aspect of our current research is to obtain a better understanding of the programs and measures currently in place, and the effectiveness of these at reducing storm threats. To this end, a mail questionnaire was administered to high-hazard coastal localities in Gulf and Atlantic coast states (including four communities in Hawaii). This questionnaire was designed to elicit answers to the following basic research questions:

1. What types of measures (including development management) are currently employed by coastal localities to reduce hurricane and storm hazards?

2. How effective are these measures at reducing storm hazards?

3. What are the major characteristics of coastal development, and what are the factors which influence these characteristics?

4. What are the major factors which influence the political acceptability of hazard mitigation measures?

5. What are the factors which influence the effectivenss of mitigation measures?

Each of these questions is considered in turn in the sections which follow. Section II provides a brief description of the localities surveyed including the methodology behind their selection. Section III reviews some of the more important characteristics of responding and responding localities, including such information as the geographical distribution of communities, their population size and economic base, the type of job held by the respondent, and so on. Section IV provides information on the political salience and priority afforded the hurricane hazard by local governing bodies, while section V reviews the general patterns and characteristics of development in

responding localities. The respondents' knowledge of the time it would take to evacuate the locality in case of a hurricane is examined in Section VI, and the role of regional and state governments in storm hazard mitigation is examined in Section VII.

Section VIII presents an assessment of the types of mitigation programs, including development management, currently in use in responding localities, and the perceived effectiveness of these at reducing local storm hazards. In Section IX, simple bivariate relationships between survey variables are computed and examined to better understand the forces shaping development and development patterns in coastal localities. Sections X and XI apply a similar set of techniques to explore influences on the feasibility of development management measures, and the effectiveness of these measures respectively. Section XII examines the extent to which more stringent development management measures have been adopted following hurricanes and severe coastal storms. Finally, a summary and set of conclusions are provided in Section XIII of the report.

In addition, three appendices are provided. Appendix A lists references cited in the text, and Appendix B presents a complete listing of the coefficients computed for the bivariate analyses in Sections IX, X and XI. Appendix C provides the full text of the survey instrument.

II. Description of the Survey Population

The questionnaire was designed to document and evaluate mitigation efforts of those coastal localities which are most susceptible to hurricane and coastal storm forces. The "Velocity-Zone" or "V-Zone" designations provided by FEMA under the National Flood Insurance Program (NFIP) were used to identify these localities. Technically these are coastal waterfront areas which it has been determined are of sufficient fetch to support a minimum

three-foot wave (see U.S. Army Corps of Engineers 1975). Under NFIP these are areas where higher actuarial flood insurance rates apply and in which special building provisions are required.

A list of local jurisdictions containing V-zones was compiled from several sources. First, an initial list was acquired from the most recent FEMA "communities file" -- the data set in which FEMA stores basic information required for NFIP administration.

To obtain a more recent updating of this list, and to include localities which are currently being studied for V-Zone designation (under the new wave height methodology), a second list providing the names of study consultants and jurisdictions being studied was used to supplement the communities file. FEMA officials indicated that between these two lists, 95% to 100% of V-Zone localities would be obtained. As a further double check, NFIP State Coordinators in every relevant state were contacted and asked to provide an independent list of localities with V-Zones in their state. This list was then compared with, and served to supplement, the above lists.

Because we felt that coastal jurisdictions of very small population were unlikely to be undertaking serious development management programs, and in an attempt to keep the survey size to a manageable level, localities of less than 1,000 in population (as of the 1980 census) were not surveyed. In the end, hurricane questionnaires were mailed to 634 communities in 18 Gulf and Atlantic coast states (Alabama, Connecticut, Deleware, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Texas, Virginia). In addition, four counties in Hawaii were included.

Each V-Zone locality received a questionnaire in early June. Approximately two weeks after this initial mailing a reminder letter was sent. After

another two weeks, a second questionnaire with another reminder letter was mailed. Finally, for those localities which had not yet responded by late August, a letter asking them to indicate why they did not respond was sent. As of December 1, 1984, 420 survey responses had been received, for a preliminary response rate of 66%. From the final correspondence made with those localities that had not responded, we attempted to learn whether we had inadvertantly mailed questionnaires to localities which did not contain coastal storm hazards. From this we were able to eliminate 15 non-hazard localities, bringing our overall survey population to 619. This in turn increased the overall response rate to about 67.8%. In addition several localities were deleted for consistency reasons, primarily because they contained less than 1,000 in population. This brought the final number of useable survey responses to 403.

III. Characteristics of Respondents and Respondent Communities

A. Geographical Location of Respondents

Storm hazard localities were surveyed form Maine to Texas, with the addition of Hawaii. Survey localities have been placed in the following geographical zones: New England (Maine, New Hampshire, Massachusetts, Connecticut), Mid-Atlantic (Delaware, Maryland, New Jersey, New York, Rhode Island), Southeast (Georgia, North Carolina, South Carolina, Virginia), Gulf (Texas, Louisiana, Alabama, Mississippi, Florida) and Pacific (Hawaii). The distribution of respondents by geographical area and state is listed in Table 1.

The highest numbers of responses exist for the Gulf and Mid-Atlantic regions with 42% and 26% respectively of the total survey respondents. A quick perusal of the quantity of localities surveyed in each state indicates that sharp differences exist, and this is a source of possible bias. Florida

Table 1

Distribution of Respondents by Geographical Region and State

Region/State	Adjusted Survey Population*	Survey Responses**	Percent of Total Respondents	Response Rate
New England	117	68	16.7%	58.1%
Connecticut	19	10	2.4	52.6
Maine	24	19	4.7	79.2
Massachusetts	70	39	9.6	55.7
New Hampshire	4	0	0	0
Mid-Atlantic	169	103	25.8%	60.9%
Delaware	6	6	1.5	100.0
Maryland	20	17	4.2	85.0
New Jersey	60	35	8.8	58.3
New York	65	32	8.1	49.2
Rhode Island	18	13	3.2	72.2
Southeast	71	57	14.2%	80.3%
Georgia	17	10	2.4	58.8
North Carolina	22	18	4.4	81.8
South Carolina	21	20	5.2	95.2
Virginia	11	9	2.2	81.8
Gulf	240	171	42.3%	71.2%
Alabama	8	4	1.0	50.0
Florida	153	119	29.2	77.7
Louisiana	22	14	3.4	63.6
Mississippi	11	6	1.5	54.5
Texas	47	28	7.1%	59.6%
Pacific	4	4	1.0	100.0
Hawaii	4	4	1.0	100.0
Total	602	403	100.0%	66.9%

*Subtracting non-respondents who indicated no storm hazard existed, localities under 1,000 in population, and other deletions.

**Note that an earlier version of this report, dated January 1985, contained N=420.

represents the location of the largest number of respondents (29.2%), followed by such states as New York and Massachusetts. A more detailed analysis of the possible influences of state location is provided in Section X of this report. A comparison of the location of jurisdictions receiving the survey, and those that actually responded, indicates that certain states and regions also have larger response rates than others. This may be another source of possible bias. As can be seen above, response rates range from a high of 100% in such states as Hawaii to a low of 0% in New Hampshire. These are states, however, which contain very few V-zone communities. The survey population included both counties and cities and towns (and other sub-county jurisdictions).

B. Locality Size and Population

The population of the survey localities varies widely. By definition they are at least 1,000 in permanent population, but range upward as high as several million (e.g., in the case of New York City). As Table 2 indicates, over 70% of the responding localities have permanent populations of less than 50,000. About 50% of the survey population lies within the 5,000 to 50,000 range.

Table 2

Respondent Localities by Permanent Population Size (NV145)

	Frequency	Percentage
1,000 - 4,999	79	19.6%
5,000 - 9,999	137	33.9
20,000 - 49,999	65	16.1
50,000 - 99,999	54	13.4
Over 100,000	68	16.9

(N=403)

The geographical size of respondent localities also varied considerably, from a high in the thousands of square miles to a low of less than one square mile. Table 3 provides information concerning the ranges of these sizes. The relatively balanced range of geographical sizes is in part a reflection of the combination of counties, cities and town in the survey population.

Table 3

Respondent Communities by Area (NV150)

	Frequency	Percentage
Less Than 5 Square Miles	80	21.8%
5 - 9 Square Miles	44	12.0
10 - 19 Square Miles	62	16.9
20 - 39 Square Miles	48	13.1
40 - 99 Square Miles	36	9.8
100 and over Square Miles	96	26.2
(N=366)		

C. Economic Base of Responding Localities

The economic base of responding localities is mixed, with service and trade, tourism and retirement indicated by the most number of localities as at least somewhat important (95%, 89% and 86% respectively). Tourism and recreation received the greatest number of "very important" ratings (44%), followed by service and trade (28%). On the other hand, agriculture was rated as being important by less than half of the respondents. Manufacturing and fishing were each indicated as important by three-quarters of the respondents.

Table 4

Economic Base of Respondent Localities

	Not Important 1	2	3	4	Very Important 5	Average Importance Score
Tourism and Recreation (V151) N=384	10.7%	11.7%	17.4%	16.4%	43.8%	3.71
Manufacturing (V152) N=375	27.2	22.7	16.0	14.7	19.5	2.76
Service and trade (V153) N=380	4.9	7.5	27.7	32.1	27.7	3.70
Retirement (V154) N=381	13.6	19.7	25.5	23.1	18.1	3.12
Fishing (V155) N=377	23.6	22.3	21.5	16.7	15.9	2.79
Agriculture (V156) N=371)	49.6	17.3	11.3	10.2	11.6	2.17

The calculation of an average importance score for each sector indicates that tourism and recreation (3.71) and service and trade (3.70) are indicated as being the most important variables.

D. Position and Length of Employment of Respondents

Where possible the questionnaire was sent to a local planning director. Where there was no local planner, it was sent to a city manager or county administrator. When these officials did not exist, building inspectors, mayors, planning board members and civil defense officials were the recipients. The breakdown below (Table 5) indicates the distribution of respondents by job title. As desired, the majority of survey respondents were planning directors or staff planners.

Table 5

Respondents by Job Title (V160)

	Frequency	Percent
Planning Director/Planner/Engineer	200	51.2
Chairman of Planning Board/Mayor	58	15.5
City Manager/County Administrator/Town Clerk	47	12.0
Building Inspector/Official	35	9.0
Emergency Management/Civil Defense	19	4.9
Others	32	8.2

(N=391)

The length of time that these respondents had been employed in the jurisdiction varies greatly, from a low of a few months to over 50 years.

Table 6

Length of Employment (NV161)

	Frequency	Percent
Less than 5 Years	164	42.1%
5 to 9 years	100	25.6
10 to 19 years	97	24.9
20 and Above	29	7.4

(N=393)

Over 40% of the respondents, it should be noted, have worked in the jurisdiction for less than five years. This suggests that the local experience level of key individuals may be limited, as well as their understanding and memory of past storm events.

E. Planning Staff

As the ability of a locality to effectively plan for a storm event is dependent upon the staff, expertise, and resources available, we asked respondents to indicate the approximate number of full-time staff employed in their planning departments. This number ranged from 0 to a high of 400 (New York City). As expected greater planning expertise and resources exist in larger communities:

Table 7

Number of Full-time Planning Staff

Population	Less than 5	5-9	10-24	25 and over
Less than 5,000	65 (16.7%)	9 (2.3%)	0	0
5,000-19,000	130 (33.4%)	3 (0.8%)	2 (0.5%)	0
20,000-49,000	47 (12.1%)	12 (3.1%)	5 (1.3%)	0
50,000-100,000	17 (4.3%)	23 (5.9%)	11 (2.8%)	1 (0.3%
Over 100,000	14 (3.6%)	13 (3.3%)	19 (4.9%)	18 (4.6%)
Total	273 (70.2%)	60 (15.4%)	37 (9.5%)	19 (4.9%)

IV. Priority Given to the Storm Threat

Current literature and thinking about the politics of natural hazards suggests that storm threats are of relatively low importance to public officials (e.g., Rossi, Wright, and Weber-Burchin 1982; Drabek, Mushkatel and Kilijanel 1983). We expected similar results from our questionnaire. Approximately 73% of the respondents, however, indicated that their jurisdiction's governing body considered the threat of severe coastal storms of at

Table 8

Priority of Storm Hazard to Elected Governing Body
in Comparison With Other Local Issues (V2)

	Frequency	Percent
Very High Priority	66	16.5
High Priority	120	30.0
Medium Priority	105	26.3
Low Priority	81	20.3
Very Low Priority	28	7.0

(N=400)

least medium priority in comparison with other local issues. Close to half of the respondents (46.5%) indicated storm threats to be of either high or very high priority.

Thus in apparent contrast to much of the recent natural hazards literature, a substantial percentage of coastal localities consider the storm threat of high importance, compared to other local issues. A partial explanation for this is that coastal localities would feel the full force of a coastal storm and have the most to lose (i.e., the risk to people and property is greatest here) should a hurricane or severe storm occur.

V. Patterns and Characteristics of Development

A. Extent of the Hazard Area

Localities responding to the questionnaire had substantial portions of their jurisdictions within flood zones. Approximately half of the respondents had over 20 percent of their jurisdiction (land in A and V Zones) in the 100-year coastal floodplain. Roughly one-quarter of the respondents were in jurisdictions where 50% or more of the jurisdiction was located in these high

hazard areas, and more than 80% of the respondents had 5% or more of their jurisdiction in these hazard areas.

Table 9

Percentage of Jurisdiction's Land Area in 100-Year Coastal Floodplain (V-Zones and A-Zones Under NFIP) (V3)

	Frequency	Percent
Less than 5%	70	17.5%
5 - 19%	132	33.0
20 - 49%	107	26.8
50 - 79%	41	10.3
80 - 100%	50	12.5
(N=400)		

Substantial portions of these localities, then, face severe storm hazard. Because the relative extent of this local hazard varies among respondents, we would expect that those with larger hazard areas as a percentage of total jurisdiction size would afford greater priority to the issue of storm hazard mitigation, and thus would display a greater propensity to adopt mitigation measures. The testing of this proposition is discussed in a later section on adoption feasibility.

B. Extent of Development in the Hazard Area

The extent to which these hazard areas had already been developed varied widely and with relatively even distribution among responding localities. On one extreme, approximately 17.5% of the communities had developed less than 5% of their hazard area, while on the other extreme 80-100% of the hazard area had been developed in approximately 23% of the responding localities. Over half the hazard area was developed in 44% of the responding localities.

Table 10

Percentage of 100-Year Coastal Floodplain Already Developed (V4)

	Frequency	Percent
Less than 5%	69	17.5%
5 - 19%	74	18.7
20 - 49%	77	19.5
50 - 79%	86	21.8
80 - 100%	89	22.5
(N=395)		

Extent of floodplain development may serve as proxy for hazard importance as well as a major influence or constraint on the feasibility of particular hazard mitigation responses. For instance, for a local perception of a problem to develop, it may require that a certain extent of the hazard area already be developed. As well, the use of many development management techniques is precluded in localities where extensive development in high storm hazard areas has already occurred. In these locations greater emphasis may be placed on mitigation responses which protect existing development rather than prevent the exposure of new development (e.g., see Burby and French 1981).

The percentage of the total dollar value of new development in a jurisdiction which occurs in the 100-year coastal floodplain also provides information on the extent and nature of growth in a locality, and in turn has causal implications for the importance given to storm hazard mitigation. Over 60% of the responding localities indicated that the percentage of total dollar value of development in the last five years occurring in the 100-year coastal floodplain was less than 20%. Conversely, 40% of the responding localities had development in these locations which was at least 20%, and

close to one-quarter indicated that 50% or more of the total value of new development in the last five years occurred in the floodplain. Thus while respondents leaned toward the lower percentages, a wide distribution exists on this local characteristic.

Table 11

Percentage of Total Dollar Value of New Development in Last 5 Years Occurring in 100-Year Coastal Floodplain (V14)

	Frequency	Percent
Less Than 5%	145	37.4%
5-19%	99	25.5
20 - 49%	56	14.4
50 - 79%	40	10.3
80 - 100%	48	12.4
(N=388)		

C. Uses Occurring in the Floodplain

We can also get a picture of the characteristics of responding localities by noting the uses to which hazard area land has been put and is currently being put. Clearly the most common type of land use presently in 100-year coastal floodplain is single-family detached residential uses, with approximately 72% of respondents citing this. A little less than 10% of the respondents indicated that multifamily residential uses were the most common types of land use existing in the coastal floodplain, while roughly 5% indicated that commercial and public recreational uses were most common. Industrial uses were most common in only 4% of the responding localities. While single-family detached is clearly the dominant existing use, other types

of new development have occurred in the last five years. While approximately 68% of the respondents indicated that single-family detached had indeed occurred in the last five years (in the 100-year coastal floodplain), multi-family and commercial (including private recreational and hotel/motel uses) had also occurred in 45% and 36% of the localities respectively. Twenty-one percent of the respondents indicated that public recreational/park land uses had occurred, while 10% indicated that industrial development had taken place.

Table 12

Most Common Type of Land Use in 100-Year Coastal Floodplain (V5)

	Frequency	Percent
Single-family Detached	261	71.9%
Multi-family	35	9.6
Commercial	18	5.0
Industrial	14	3.9
Public Recreational/Parkland	17	4.7
Silva Culture	8	2.2
Other	8	2.2

(N=363)

Thus, while single-family detached remains the most common floodplain uses, other uses are also being more prominent in coastal floodplains. In particular the data indicates increasing multifamily uses, including condominium and high density residential, and commercial uses, including hotel/motel developments.

Table 13

Types of New Development That Have Occurred in 100-Year Coastal Floodplain in Last Five Years*

	Frequency	Percent
Single-family Detached (V6) N=396	270	68.2%
Multi-family (V7) N=396	178	44.9
Commercial (V8) N=396	141	35.6
Public Recrational/Parkland (V10) N=396	85	21.5
Industrial (V9) N=396	38	9.6

*Respondents were asked to check all relevant categories.

D. Availability of Hazard-Free Development Sites

Another important characteristic of the local development climate and pattern, is the extent to which hazard-free or less hazardous building sites can be found outside of the 100-year coastal floodplain. Wide and relatively uniform variation occurred on this question as well. Approximately 47% of the responding localities indicated that residential development sites outside of the 100-year coastal floodplain were abundant or very abundant, while approximately 33% said that such sites were either scarce or very scarce. A sizeable 19% indicated that such sites were moderately scarce. The availability of the hazardous building sites may serve to influence significantly the feasibility and effectiveness of development management programs designed to redirect growth away from, or to require lower density growth within, high storm hazard zones. Pressure to build in these locations, regardless of the risk, will tend to increase, it is hypothesized, when equivalent or similar parcels are less available elsewhere. In this development climate such development management measures are likely to be less feasible, and eclipsed by an

emphasis on structural improvements to buildings and the coastal environment in general.

VI. Evacuation Knowledge

In most of the localities receiving the questionnaire the issue of evacuation in the event of hurricane should be quite important. Surprisingly, however, when asked if they knew how long it would take to evacuate their jurisdiction, more than half (55.5%) indicated they did not. A comparison of this response with the population size of the locality, indicates that a large portion of those localities that do not know this information are small in size, and thus expectedly low in local expertise and hazard management capacity. About 55% of the respondents indicated they did not know how long it take to evacuate were in jurisdictions of less than 20,000 in population.

Table 14

Do You Know How Long It would Take to Safely Evacuate Your Jurisdiction?

Population	Yes	No
Less than 5,000	41 (10.3%)	38 (9.6%)
5,000 - 19,000	52 (13.1%)	85 (21.4%)
20,000 - 49,000	25 (6.3%)	38 (9.6%)
50,000 - 100,000	18 (4.5%)	33 (8.3%)
Over 100,000	41 (10.3%)	27 (6.8%)
Total	177 (44.5%)	221 (55.5%)

For those localities where respondents did know this figure, or were at least able to estimate it, evacuation times ranged from 1 hour to 72 hours.

VII. The Role of Regional and State Governments

An important question in storm hazard mitigation is the appropriate role of states and regional bodies in both encouraging the adoption of mitigation strategies and in assisting in the actual development and implementation of such programs. Several questions on the survey dealt specifically with the assistance and involvement of such governments. When asked whether the respondent was familiar with state programs providing assistance to localities in storm hazard mitigation, nearly three-quarters (70.5%) indicated that they were either somewhat familiar or very familiar. The respondents were also asked to indicate which types of assistance, if any, they had received from state agencies in the last five years. As Table 15 indicates, most localities had received floodplain maps and information about the National Flood Insurance Program, and about half had received assistance in developing a disaster preparedness plan. Other types of assistance were considerably less frequent.

Localities were also asked to indicate the specific types of contacts they had had with state personnel in the last year concerning storm hazard management. As Table 16 indicates, a large number of responding localities had some type of contact. Telephone contacts were most frequent, followed by correspondence, personal visits, and the receipt of technical reports on hurricane hazard mitigation.

A high percentage, approximately 56.5% indicated that a regional agency in their area has been involved in local storm hazard mitigation. Of these respondents the most typical type of involvement was the preparation of a regional evacuation plan (76.5%), followed by modelling or simulating storm impacts for their region (40.5%). About one-third of these respondents indicated that a regional agency had prepared a regional hazard reduction plan

Table 15

Types of State Assistance Provided in the Last Five Years*

	Frequency	Percent
Information on the National Flood Insurance Program (V121) N=382	338	88.5%
Floodplain Maps (V119) N=382	294	77.0
Help With Disaster Preparedness Plans (V123) N=382	200	52.4
Hydrologic Data (V120) N=382	105	27.5
Help With Storm Drainage Problems (V122) N=382	87	22.8
Help in Administering Hazard Area Regulations (V124) N=382	76	19.9
Grants or Loans for Construction of Storm Protection Works (V125) N=382	68	17.8
Grants or Loans for Acquisition of Hazard Area Property (V126) N=382	23	6.0

*Respondents were asked to check all relevant categories.

Table 16

Types of Contact with State Government Personnel in the Last Year Concerning Storm Hazard Management*

	Frequency	Percent
Telephone Contacts (V128) N=384	213	55.5%
Correspondence Related to storm hazard management (V129) N=384	207	53.9
Personal visits (force-to force contact) (V127) N=384	189	49.2
Received technical reports on hurricane hazard mitigation (V130) N=383	140	36.6
No contact during the past year (V134) N=384	93	24.2

*Respondents were asked to check all relevant categories.

(36.5%) and had assisted the locality in developing a storm hazard management plan (35.5%).

VIII. Coastal Storm Mitigation Programs and Their Effectiveness

A. Explicit Storm Hazard Reduction Strategies

Respondents were asked if their locality had adopted an explicit storm hazard reduction strategy in addition to their participation in the National Flood Insurance Program. Surprisingly, about half (50.7%) of the respondents indicated that such an explicit strategy did exist. Of those who indicated that their locality had such a strategy, they were further asked to indicate the more specific objectives of such a strategy. Ten objectives were listed in the questionnaire with respondents permitted to circle as many objectives as were applicable. As shown in Table 17, the two most frequently selected objectives (by about 60% of the respondents in each case) were: 1) conserving the protective features of the natural environment and 2) increasing the ability of private structures and facilities to withstand storms. The two objectives most closely related to development management also received a high percentage of responses: guiding new development into less hazardous areas and locating public facilities in less susceptible areas. On the other hand relocation, either of private or public structures and facilities, is not an objective frequently pursued by these high hazard coastal localities. These ten storm hazard reduction objectives are listed below in their rank order according to frequency.

B. Programs Which Structurally Alter the Coastal Environment

Three questions on the survey dealt with the specific programs and measures which localities had in place which, either by design or by effect, served to reduce storm hazards. Each question pertained to a particular

Table 17

Objectives of Storm Hazard Reduction Strategy*

Rank Order	Frequency	Percent
1. Increasing ability of private structures and facilities in hazardous areas to withstand storm forces (V23) N=203	122	60.1%
2. Conserving protective features of the natural environment (e.g., dune protection) (V26) N=203	119	58.6
3. Increasing evacuation capacity (V21) N=203	98	48.3
4. Increasing ability of public structures and facilities in hazardous areas to withstand storm forces (V24) N=203	96	47.3
5. Locating new public facilities and structures in areas less susceptible to storm hazards (V18) N=203	93	45.8
6. Guiding new private development into areas less susceptible to storm hazards (V17) N=203	92	45.3
7. Provision of adequate storm shelters (V22) N=203	82	40.4
8. Structurally-altering and/or reinforcing the coastal environment (e.g., seawalls, bulkheads) (V25) N=203	70	34.5
9. Relocation of existing public facilities and structures into less-hazardous areas (V20) N=203	12	5.9
10. Relocation of existing private development into less hazardous areas (V19) N=203	9	4.4

*Respondents were asked to check all relevant categories.

category of storm reduction programs. The first related to actions or desires which served to structurally modify or alter the coastal environment. Included in this category are sand trapping structures (e.g. groins, jetties), sand moving programs (e.g., beach nourishment, beach scraping), shoreline protection works (e.g., bulkheads, seawalls, revetments), and flood control

works (e.g., dikes, channels, retaining ponds). As shown in Table 18, substantial use of each of these approaches was found, although shoreline protection works was a clear leader with more than two-thirds of the responding localities indicating that such measures were in use (70%). The use of sand trapping, sand moving and flood control works was about even, with approximately one-third of the responding localities using these. (Note that respondents could select multiple categories on their response.)

Table 18

Programs Which Structurally Alter the Coastal Environment

	Currently in Use	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Shoreline protection works (V32) N=403	281	69.7%	3.20	97	34.5%
2. Flood Control works (V33) N=403	136	33.7	3.48	66	48.5
3. Sand Moving programs (V31) N=403	126	31.3	2.76	32	25.4
4. Sand trapping structures (V30) N=403	136	33.7	2.72	30	22.1

*4s and 5s on a five-point scale

Respondents were also asked to evaluate the extent to which these programs tended to reduce local storm hazards. By comparing an average effectiveness score for each type of approach, a better idea of which are most successful in reducing storm hazards can be obtained. Flood control works and shoreline protection receive the highest effectiveness ratings, with the remaining two categories falling considerably behind. Sand trapping structures received the lowest rating even though it was used by almost as many localities as flood control works.

C. Programs Which Strengthen Buildings and Facilities

The second category of programs asked about were those designed to strengthen actual buildings and structures, and the private and public facilities that accompany them (see Table 19). As expected, almost all responding localities had a building code in place (90%) and had met the minimum elevation and floodproofing standards required by FEMA under the provisions of the National Flood Insurance Program (94%). About 47% of the respondents indicated that they had special storm resistant building standards in place, and well over one-third were floodproofing public facilities and structures. Only 15% of the responding localities, however, had adopted

Table 19

Programs and Policies Which Strengthen Buildings and Facilities

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Minimum elevation and floodproofing under NFIP (V39) N=403	378	93.8%	3.88	243	64.3%
2. Building code (V37) N=403	362	89.8	3.62	189	52.2
3. Special storm-resistant standards (V38) N=403	190	47.1	3.82	120	63.2
4. Floodproofing of public facilities and structures (V41) N=403	162	40.2	3.47	79	48.8
5. More extensive elevation and floodproofing (V40) N=403	60	14.9	3.98	43	71.7

*Number of 4s and 5s on a five-point scale

elevation and floodproofing standards which were more stringent than those required under NFIP.

D. Development Management Measures

The concept of "development management" is defined for the respondent in the beginning of the survey to include "programs and policies which control or influence the location, density, timing and type of development which occurs in a jurisdiction." Respondents were asked to indicate which more specific development management tools and measures were currently used in their jurisdiction, and the extent to which they serve to reduce local storm hazards. Respondents were asked to answer this question even if a program or policy was not specifically designed to reduce storm hazards.

The specific development management measures were presented in question 12 of the survey and were organized under six headings: 1) planning, 2) development regulation, 3) public facilities policy, 4) taxation, financial and other incentives, 5) public acquisition, and 6) information dissemination. Overall, 21 different measures were listed in this question, ranging from zoning and subdivision provisions to below market property taxes.

An initial way to get a handle on the extent of the use of these techniques by respondent localities is to see how many localities used how many different techniques. Table 20 below separates localities according to the number of measures currently in use. Most localities are using some form of development management as we have defined it. Approximately 29% of the localities are using five techniques or fewer. Consequently, more than 70% of the respondents have six or more techniques currently in use. About 16% have eleven or more of these measures in use. The majority of localities, roughly 55%, fall within the 6 to 10 range.

Table 20

Number of Development Management Measures in Use (NV168)

Number of DM Measures	Frequency	Percent
0-5	117	29.0%
6-10	223	55.3
11-15	56	13.9
Over 15	7	1.7
N=403		

Following is a more detailed look at the specific development management measures contained within each subcategory. It should be remembered that respondents were asked to indicate the use and effectiveness of these measures regardless of whether they are explicitly designed to reduce storm hazards.

1. Planning

Under planning instruments, as shown in Table 21, the comprehensive or land use plan was the most frequently circled. Indeed, some 84% of the respondents indicated that they had such a plan. Evacuation plans ranked second in frequency with 68% of the localities having such a plan, while the capital improvements program ranked third, with about half the respondents indicating its use. Not surprisingly, plans and policy documents dealing specifically with the reduction of storm hazards were considerably fewer in number. About 20% of the respondents indicated that they had hurricane/storm components of their comprehensive plans, and about 22% had recovery/reconstruction plans or policies.

Table 21

Planning Measures

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Comprehensive/land use plan (V45) N=403	340	84.4%	2.94	89	26.2%
2. Evacuation plan (V49) N=403	272	67.5	3.53	144	52.9
3. CIP (V47) N=403	216	53.6	2.53	35	16.2
4. Recovery/reconstruction plan or policies (V48) N=403	87	21.6	2.98	21	24.1
5. Hurricane/storm component of comprehensive plan (V46) N=403	80	19.9	3.33	31	38.8

*4s and 5s on a five-point scale

2. Development Regulation

This category includes traditional land use controls, and particularly zoning and subdivision regulations. These two measures are currently in use in most responding communities. As shown in Table 22, approximately 88% of the responding localities had zoning in place, and 86% had subdivision regulations. Approximately half of the respondents have shoreline setback provisions, while 38% and 27% respectively, have dune protection and special hazard area ordinances.

3. Capital Facilities Policy

One potentially effective approach to influencing growth and development in a locality is through decisions concerning the construction and location of public facilities, public structures, and other public investments. Two entries were provided for capital facilities policy (see Table 23).

Table 22

Development Regulation

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Zoning ordinance (V50) N=403	354	87.8%	3.16	123	34.7%
2. Subdivision ordinance (V51) N=403	347	86.1	3.06	116	33.4
3. Shoreline setback (V53) N=403	218	54.1	3.59	120	55.0
4. Dune protection (V52) N=403	152	37.7	3.69	88	57.9
5. Special hazard area ordinance (V54) N=403	109	27.0	3.85	71	65.1

*4s and 5s on a five-point scale

Table 23

Capital Facilities Policy

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Location of public structures and buildings (e.g., hospitals, schools) to reduce extent of risk to public investments (V56) N=403	185	45.9%	3.67	87	47.0%
2. Location of capital facilities to reduce or discourage development in high hazard areas (V55) N=403	126	31.3	3.43	48	38.1

*4s and 5s on a five-point scale

Unlike the entries in the previous section, these two capital facilities entries are much more explicitly storm hazard related. Indeed, to circle one leaves little doubt -- as is the case when zoning is indicated -- that hurricane or storm hazard reduction is the intended objective. While a majority of responding localities do not employ either of these policies, at least one-third of the respondents do; this is a significant conclusion (see Table 23). There remains an ambiguity in the language of these entries as to the precise form such capital facility policies take. Are they, in fact, explicitly developed and adopted by the governing body (i.e., formal policies and development "rules" the jurisdiction follows) or, on the other hand, are they more informal criteria that local planners and public officials use when making capital facilities decisions? This is a question left unresolved from the survey data.

4. Taxation, Financial and Other Incentives

Three types of measures were included under this heading: reduced or below market taxation, impact taxes or special assessments, and devices for the transfer of development potential. Each of these entries, as the precise wording below will indicate, is specific to the mitigation of storm hazards. Consequently, as with the public facilities policies, there is less ambiguity here as to whether devices in use in the locality are in place for non-hazard reasons and just happen to reduce to some extent local storm hazards. As shown in Table 24, however, relatively few responding localities are using these techniques. Impact taxes/special assessments received the smallest number of responses (1.7%) followed by reduced or below market taxation 10.9%. While development transfer measures were substantially less-frequently used than development regulations such as zoning and subdivision, they are nonetheless being used by a significant number of responding localities (21%).

Table 24

Taxation, Financial and Other Incentives

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Transfer of development potential from hazardous to non-hazardous sites (e.g., clustering, planned unit development) (V59) N=403	84	20.8%	3.46	36	42.9%
2. Reduced or below market taxation for open space and non-intensive uses of hazard areas (V57) N=403	44	10.9	3.00	12	27.3
3. Impact tax or special assessment to cover the additional public costs of building in hazard zone (V58) N=403	7	1.7	3.71	3	42.9

*4s or 5s on a five-point scale

Because this entry could encompass a number of specific mechanisms (TDR, clustering, PUD) it is difficult to know precisely how these localities are transfering development from high to low hazard areas.

5. Public Acquisition

One effective approach to storm hazard mitigation is simply to purchase undeveloped land in high hazard areas and to keep this land in public hands, preempting its availability for private development. One option here is to purchase the fee-simple title for the land (all the rights to the land), while another option is simply to purchase the "development rights" to this land (an easement restricting development). The former is a more traditional approach,

and, as shown in Table 25, a substantial number of respondents indicated that such an approach was in use in their locality (29%). A significant number of respondents indicated that they were using the second approach -- the purchase of development rights or easements in high hazard areas -- though considerably fewer than those using fee simple (13.9%). Two other approaches are included in this section of the questionnaire: programs to purchase damaged buildings and structures in hazard areas, and programs to relocate structures outside the hazard areas. An extremely small number of responding localities had such programs (only 12 and 9 localities respectively). Relocation of structures, and the purchasing of damaged structures in hazardous areas are not generally approaches frequently used by coastal localities.

Table 25

Public Acquisition

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Acquisition of undeveloped land in hazardous areas (e.g., for open space) (V60) N=403	118	29.3%	3.58	62	52.5%
2. Acquisition of development rights or scenic easements (V61) N=403	56	13.9	2.88	15	26.8
3. Acquisition of damaged building in hazardous areas (V62) N=403	12	3.0	3.55	6	50.0
4. Building relocation program (moving structures) (V63) N=403	9	2.2	3.33	3	33.3

*4s or 5s on a five-point scale

Again, these entries are much more storm hazard specific than earlier entries, consequently increasing the significance and relevance of the responses. One problem arises from attempts at collecting information about the use of acquisition at one point in time. While a responding locality may have purchased a large portion of its hazard area land several years ago (and perhaps now hold it in a public trust), it may not indicate having such a program because the technique is technically not currently "in use," as the questionnaire asks. More coastal localities may have used this technique in the past than this aggregate figure would suggest.

6. Information Dissemination

Models of rational behavior suggest that individuals will make responsible decisions if they have access to all the relevant information. This belief has spurred much interest in programs designed to inform the housing consumer, the developer/builder and the general public about the risks associated with hurricanes and severe coastal storms (e.g., see Palm 1981). Two types of programs are listed under this heading: hazard disclosure in real estate transactions and construction practice seminars. As shown in Table 26, approximately 26% of the responding localities indicated that they have hazard disclosure provisions in place, while approximately 15% indicated that construction practice seminars were being offered.

Table 26

Information Dissemination

	Frequency	Percent	Average Effectiveness Rating	Number of High Effect Rankings*	Percent
1. Hazard disclosure require-ments in real estate transactions (V64) N=403	103	25.6%	2.93	24	23.3%
2. Construction practice seminars for builders (V65) N=403	62	15.4	3.24	21	33.9

*4s or 5s on a five point-scale

In addition, several respondents indicated that they had some kind of education programs for the general public. This type of program would be designed to enhance general local awareness, and could in turn lead to changes in consumer behavior and resulting local development patterns.

In summary, Table 27 presents a listing of specific development management measures ordered according to the frequency of their use.

Table 27

Development Management Measures in Order of Frequency Used

Rank	Type of Measure	Number of Survey Communities Using It
1.	Zoning ordinance	354
2.	Subdivision ordinance	347
3.	Comprehensive/land use plan	340
4.	Evacuation plan	272
5.	Shoreline setback regulation	218
6.	Capital/improvement program	216
7.	Location of public structures and buildings to reduce storm risks	185
8.	Dune protection regulations	152
9.	Location of capital facilities to reduce or discourage development in high hazard areas	126
10.	Acquisition of undeveloped land in hazardous areas	118
11.	Special hazard area ordinance	109
12.	Hazard disclosure requirements in real estate transactions	103
13.	Transfer of development potential from hazardous to non-hazardous sites	84
14.	Recovery/reconstruction plan or policies	87
15.	Hurricane/storm component of comprehensive plan	80
16.	Construction practice seminars	62
17.	Acquisition of development rights or scenic easements	56
18.	Reduced or below market taxation	44
19.	Acquisition of damaged buildings in hazardous areas	12
20.	Building relocation program	9
21.	Impact taxes or special assessments	7

Following is a ranking of these specific development management measures by their perceived effectiveness at reducing local storm hazards:

Table 28

Development Management Measures in Order of Perceived Effectiveness

Rank	Type of Measure	Average Effectiveness Rating	Percent High Effectiveness Ratings*
1.	Special hazard area ordinance	3.85	65.1%
2.	Impact taxes or special assessments	3.71	42.9
3.	Dune protection regulations	3.69	57.9
4.	Location of public structures to minimize risk	3.67	47.0
5.	Shoreline setback regulations	3.59	55.0
6.	Acquisition of undeveloped land in hazardous areas	3.58	52.5
7.	Evacuation plan	3.53	52.9
8.	Acquisition of damaged buildings in hazardous areas	3.55	50.0
9.	Transfer of development potential from hazardous to non-hazardous sites	3.46	42.9
10.	Location of capital facilities to reduce or discourage development in high hazard areas	3.43	38.1
11.	Hurricane/storm component of comprehensive plan	3.33	38.8
12.	Building relocation program	3.33	33.3
13.	Construction practice seminars for buildings	3.24	33.9
14.	Zoning ordinance	3.16	34.7
15.	Subdivision ordinance	3.06	33.4

Table 28 (continued)

Development Management Measures in Order of Perceived Effectiveness

Rank	Type of Measure	Average Effectiveness Rating	Percent High Effectiveness Ratings*
16.	Reduced or below market taxation	3.00	27.3%
17.	Recovery/reconstruction plan or policies	2.98	24.1
18.	Comprehensive/land use plan	2.94	26.2
19.	Hazard disclosure requirements in real estate transactions	2.93	23.3
20.	Acquisition of development rights or scenic easements	2.88	26.8
21.	Capital improvements program	2.53	16.2

*4s or 5s on a five-point scale

E. Ranking the Three Mitigation Approaches

Respondents were also asked to rank the importance of the three broad categories of approaches above in reducing storm hazards in their jurisdiction. Respondents were to order these by placing either a 1, 2, or 3, with 1 the most important and 3 the least. Of the three approaches, development management by far received the most number of "1" responses (see Table 29). Strengthening buildings and facilities received the most number of number "2" rankings, while structural reinforcement of the coastal environment received the most number of third rankings.

F. Overall Effectiveness

Respondents were asked to consider all of the strategies and techniques they have in use in their jurisdiction and to rate the combined effectiveness of these at reducing local storm hazards. Most respondents felt that local

Table 29

Ranking of the Mitigation Strategies Based on Overall Importance in Reducing Local Storm Hazard

	Most Important 1	Rankings Percent 2	Least Important 3
1. Structural reinforcement of coastal environment (V69) N=384	84 (21.9%)	115 (29.9%)	185 (48.2%)
2. Strengthening building and facilities (V70) N=385	100 (26.0)	180 (46.8)	105 (27.3)
3. Development management (V71) N=389	211 (54.2)	85 (21.9)	93 (23.9)

programs were at least partially effective. Over 70% believed their combined programs were either moderately effective or very effective, while only a small 6% believed these programs were not effective at all. The majority of respondents (58%) placed their localities in the "moderately effective" category. This suggests that the majority of localities have programs which have considerable effect in reducing storm hazards (something greater than "slightly effective"), but at the same time these efforts are far from being "very effective." Thus in most responding localities much room for increased effectiveness exists.

It should be remembered that this ranking is relative to the specific responding locality. That is, even in circumstances where development management is ranked third (last) by a respondent, the locality may have a solid and innovative development management program. Its lower ranking may be attributable, for instance, to the importance of structural improvements (e.g., in the case where a large amount of the hazard area has already been developed).

Table 30
Overall Effectiveness (V72)

		Frequency	Percent
1.	Very effective	48	12.5%
2.	Moderately effective	223	57.9
3.	Slightly effective	92	23.9
4.	Not effective	22	5.7

N=385

G. The Influence of the State on Mitigation

One potentially important influence on the adoption of storm hazard mitigation and development management program is the specific state in which respondent jurisdictions lie within. Particular states, such as Florida and Massachusetts, are relatively active in coastal planning, both directly and through the creation of institutional and legal frameworks supportive of local programs. An initial question is whether the experiences of one particular state or set of states may serve to explain in large part variations in local development management programs. More specifically, the fact that nearly thirty percent of responding jurisdictions are located in the state of Florida raises concern about bias. Tables 31 and 32 below, provide cross tabulations of storm hazard mitigation strategies and development management measures by states. As these tables indicate, localities in Florida account for 34% of all of the explicit storm hazard reduction strategies. This suggests that although Florida localities comprise a large percentage of these programs, these figures are not larger than what might be expected from its share of the survey population. Column (C) of Table 32 provides a somewhat different perspective, indicating the percentage of respondents by state with explicit storm hazard reduction strategies. While the overall percentage for the

Table 31

Number of Communities Using Development Management Measures by State

State	Number of Development Management Techniques in Use 0-5	6-10	11-15	over 15	State Totals	Percent of Communities with 6 or More Programs
Alabama	2	2	0	0	4	50.0%
Connecticut	3	6	1	0	10	70.0
Delaware	2	4	0	0	6	66.6
Florida	24	64	27	4	119	79.8
Georgia	2	7	1	0	10	80.0
Hawaii	0	4	0	0	4	100.0
Louisiana	5	9	0	0	14	66.6
Massachusetts	12	25	2	0	39	69.2
Maryland	8	6	3	0	17	52.9
Maine	8	9	2	0	19	57.9
Mississippi	1	5	0	0	6	83.3
North Carolina	3	11	4	0	18	83.3
New Jersey	14	15	5	1	35	60.0
New York	16	9	6	1	32	50.0
Rhode Island	3	9	1	0	13	76.9
South Carolina	5	12	3	0	20	75.0
Texas	8	19	0	1	28	71.4
Virginia	1	7	1	0	9	88.8
Total	117	223	56	7	403	

Table 32

Number of Communities With Explicit Storm Hazard Reduction Strategies by State

State	(a) Frequency	(b) Percent of Total Number of Communities with Strategies	(c) Percent of State Sample
Alabama	2	.97%	50.0%
Connecticut	4	1.94	40.0
Delaware	1	.49	16.7
Florida	70	34.0	58.8
Georgia	5	2.43	50.0
Hawaii	2	.97	50.0
Louisiana	10	4.85	71.4
Massachusetts	16	7.80	41.0
Maryland	6	2.91	35.3
Maine	6	2.91	31.6
Mississippi	3	1.46	50.0
North Carolina	9	4.37	50.0
New Jersey	18	8.9	54.3
New York	14	6.80	42.4
Rhode Island	4	1.94	30.8
South Carolina	7	3.43	38.1
Texas	20	9.71	69.0
Virginia	7	3.40	77.8
Total	204	100%	

entire survey population is about 51%, the percentages for Florida localities is approximately 60%. Consequently a greater percentage of Florida localities have such programs, suggesting that the state variable, and particularly Florida, is of some importance in predicting hazard mitigation and development management programs. It should be noted, however, that such states as Louisiana, Texas and Virginia also have higher than average percentages, and Delaware and Rhode Island lower than average percentages. The number of localities upon which these percentages are based is, however, considerably smaller.

H. Comparisons of Development Management Techniques by State

To better understand patterns of development usage, the frequency and average effectiveness of these tools were compared for several key states in the population. Table 33 presents the number of localities using each development management measure in seven states: Florida, Massachusetts, North Carolina, New Jersey, New York, South Carolina, and Texas. Included in this table, as well, is the percentage of the localities in each state using a particular measure. Table 34 presents a comparison of the average effectiveness scores for development management measures within these same seven states. From this information we can gain some insight into which techniques are more prevalent, and considered more effective, in which states. It should be noted, however, that because of the low number of localities in some states relative to others, comparisons of percentages and average effectiveness scores may be somewhat deceiving.

With respect to planning measures, most states had a high use of comprehensive or land use plans, although this use was somewhat lower in Texas and Massachusetts, and higher in Florida, New Jersey and North Carolina (on a

Table 33

Comparison of Development Management Techniques by States

	Florida	Massachusetts	North Carolina	New Jersey	New York	South Carolina	Texas
Planning							
1) Comprehensive or land use plan	114 (96%)	26 (67%)	17 (94%)	32 (91%)	25 (78%)	15 (75%)	15 (54%)
2) Hurricane/storm component of comprehensive or land use plan	45 (38%)	3 (8%)	8 (44%)	5 (14%)	3 (9%)	2 (10%)	5 (18%)
3) Capital improvements program	64 (54%)	15 (38%)	7 (39%)	21 (60%)	16 (50%)	13 (65%)	17 (61%)
4) Recovery/reconstruction plan or policies	36 (30%)	4 (10%)	5 (28%)	8 (23%)	6 (19%)	5 (25%)	8 (29%)
5) Evacuation Plan	111 (93%)	12 (31%)	16 (89%)	24 (69%)	4 (13%)	17 (85%)	26 (93%)
Development Regulation							
6) Zoning ordinance	108 (91%)	37 (95%)	15 (83%)	32 (91%)	29 (91%)	16 (80%)	13 (46%)
7) Subdivision ordinance	101 (85%)	33 (85%)	17 (94%)	30 (86%)	23 (72%)	17 (85%)	25 (86%)
8) Dune protection	58 (49%)	18 (46%)	7 (39%)	11 (31%)	6 (19%)	10 (50%)	7 (25%)
9) Shoreline setback	89 (75%)	20 (51%)	13 (72%)	11 (31%)	11 (34%)	8 (40%)	4 (14%)
10) Special hazard area ordinance	33 (28%)	12 (31%)	3 (17%)	8 (23%)	12 (38%)	4 (20%)	8 (29%)

Table 33 (continued)

	Florida	Massachusetts	North Carolina	New Jersey	New York	South Carolina	Texas
Public Facilities Policy							
11) Location of capital facilities to reduce or discourage development in high hazard areas	34 (29%)	14 (36%)	6 (33%)	5 (14%)	8 (25%)	5 (25%)	15 (54%)
12) Location of public structures and buildings (e.g., hospitals, schools) to reduce extent of risk to public investments	46 (39%)	22 (56%)	11 (61%)	14 (40%)	14 (44%)	8 (40%)	17 (61%)
Taxation, Financial, Other Incentives							
13) Reduced or below market taxation for open space and non-intensive uses of hazard areas	9 (8%)	7 (18%)	-0-	3 (9%)	2 (6%)	1 (5%)	4 (14%)
14) Impact tax or special assessment to cover the additional public costs of building in hazard zone	5 (4%)	-0-	-0-	-0-	-0-	-0-	1 (3%)
15) Transfer of development potential from hazardous to non-hazardous sites (e.g., clustering, planned unit development)	34 (29%)	9 (23%)	2 (11%)	5 (14%)	7 (22%)	3 (15%)	1 (4%)

Table 33 (continued)

	Florida	Massachusetts	North Carolina	New Jersey	New York	South Carolina	Texas
Public Acquisition							
16) Acquisition of undeveloped land in hazardous areas (e.g., for open space)	37 (31%)	16 (41%)	4 (22%)	16 (46%)	16 (50%)	1 (5%)	5 (18%)
17) Acquisition of development rights or scenic easements	21 (18%)	10 (26%)	1 (6%)	5 (14%)	9 (28%)	1 (5%)	1 (4%)
18) Acquisition of damaged buildings in hazardous areas	3 (3%)	2 (5%)	-0-	-0-	2 (6%)	-0-	1 (4%)
19) Building relocation program (moving structures)	4 (3%)	1 (3%)	-0-	3 (9%)	1 (3%)	-0-	-0-
Information Dissemination							
20) Hazard disclosure requirements in real estate transactions	33 (28%)	9 (23%)	5 (28%)	5 (14%)	7 (22%)	5 (25%)	11 (39%)
21) Construction practice seminars for builders	26 (22%)	1 (3%)	4 (22%)	3 (9%)	2 (6%)	6 (30%)	8 (29%)

Table 34

Average Effectiveness of Development Techniques by State

	Florida	Massachusetts	North Carolina	New Jersey	New York	South Carolina	Texas
Planning							
1) Comprehensive or land use plan	2.97	3.08	3.06	2.48	3.40	2.73	3.33
2) Hurricane/storm component of comprehensive or land use plan	3.14	4.00	3.63	3.20	3.33	2.00	4.00
3) Capital improvements program	2.61	2.79	2.14	2.37	3.00	2.30	2.88
4) Recovery/reconstruction plan or policies	2.88	3.00	2.80	3.00	3.80	2.75	3.38
5) Evacuation Plan	3.65	3.09	3.63	3.74	3.75	3.35	3.52
Development Regulation							
6) Zoning ordinance	3.14	3.47	2.80	2.64	3.54	2.88	3.54
7) Subdivision ordinance	2.97	3.11	2.82	2.41	3.43	2.82	3.50
8) Dune protection	3.58	3.81	3.29	3.91	3.66	3.50	4.00
9) Shoreline setback	3.54	3.61	3.62	3.27	4.00	3.50	3.25
10) Special hazard area ordinance	4.00	4.09	3.33	4.13	3.92	4.00	3.75

Table 34 (continued)

	Florida	Massachusetts	North Carolina	New Jersey	New York	South Carolina	Texas
Public Facilities Policy							
11) Location of capital facilities to reduce or discourage development in high hazard areas	3.45	3.70	3.17	3.40	3.14	3.40	3.15
12) Location of public structures and buildings (e.g., hospitals, schools) to reduce extent of risk to public investments	3.56	4.05	3.56	3.50	3.69	3.63	3.58
Taxation, Financial, Other Incentives							
13) Reduced or below market taxation for open space and non-intensive uses of hazard areas	3.00	3.14	-0-	3.33	2.50	2.00	3.75
14) Impact tax or special assessment to cover the additional public costs of building in hazard zone	3.40	-0-	-0-	-0-	-0-	-0-	5.00
15) Transfer of development potential from hazardous to non-hazardous sites (e.g., clustering, planned unit development)	3.41	3.50	3.00	4.00	3.29	3.00	5.00

Table 34 (continued)

	Florida	Massachusetts	North Carolina	New Jersey	New York	South Carolina	Texas
Public Acquisition							
16) Acquisition of undeveloped land in hazardous areas (e.g., for open space)	3.68	3.71	3.75	3.43	3.38	2.00	3.40
17) Acquisition of development rights or scenic easements	2.80	3.25	1.00	3.25	2.44	-0-	5.00
18) Acquisition of damaged buildings in hazardous areas	4.00	3.00	-0-	-0-	2.50	-0-	3.00
19) Building relocation program (moving structures)	4.00	2.00	-0-	2.67	4.00	-0-	-0-
Information Dissemination							
20) Hazard disclosure requirements in real estate transactions	3.24	2.71	2.80	2.25	2.67	2.50	2.80
21) Construction practice seminars for builders	3.36	-0-	3.25	3.00	3.50	3.20	3.14

percentage basis). Texas and New York found these plans most effective, while New Jersey and South Carolina found them least effective. A higher percentage of the South Carolina, Texas, and New Jersey localities were using Capital Improvements Programs, and these were least used in Massachusetts and North Carolina. CIPs were not as highly noted in terms of effectiveness in high frequency states, although localities using them in New York, Massachusetts, and Texas found them most effective. Planning measures specifically relating to hurricane and storm hazard mitigation were more frequently used in the southern states, with highest use in Florida. Recovery policies, storm hazard components of comprehensive plans, and evacuation plans were considerably less prevalent in such states as New York and Massachusetts. These measures were generally considered by localities in most states to be more effective at reducing coastal storm hazards. In Florida, North Carolina, New Jersey, New York, and South Carolina, the evacuation plan is considered most effective (although in North Carolina the evacuation plan is tied with the storm component of the comprehensive plan). Hurricane/storm components of comprehensive plans received high scores in several states, particularly Massachusetts and Texas, but is only in use in a handful of localities there.

Under the category of development regulation, localities in most states indicate a high use of traditional zoning and subdivision ordinances. A considerably smaller portion of the Texas sample, however, is using zoning. Despite this fact, Texas localities provide relatively high average effectiveness rating for zoning and subdivision measures, along with New York, Massachusetts, and to a lesser extent Florida. As would be expected, dune protection and shoreline setbacks are more prevalent in such states as Florida, South Carolina, North Carolina, and also Massachsuetts. Surprisingly, these techniques are not as widely used, on a percentage basis,

in Texas. Little variation exists in the use of special hazard area ordinances across states. Localities in almost all the states consider dune protection, shoreline setacks, and special hazard area ordinances to be more effective than traditional regulatory measures.

Capital facilities policies were most prevalent, on a percentage basis, in the states of Texas, North Carolina, and Massachusetts. Almost all states gave relatively high effectiveness ratings to these development management measures, although they were most highly rated in Massachusetts. In all seven states, the location of public structures and buildings was considered more effective than the location of capital facilities to discourage private development.

The taxation and incentive policies were not as widely used although a significant portion of the Florida, Massachusetts, and New York samples reported using techniques involving the transfer of development potential from hazardous to non-hazardous sites. Even fewer localities were using below-market taxation, although 18% of the Massachusetts sample reported using this technique. In addition, while only five localities in Florida were using impact fees, this constitutes the major portion of all impact fee use. Transfer of development potential received reasonably good effectiveness ratings in all states, although it was particularly high in New Jersey, Massachusetts, and Texas (only one locality using it). In the small number of cases where impact fees were used, this technique also receives a relatively good effectiveness rating. The effectiveness of below-market taxation is generally deemed to be lower in almost all states where is is used.

Public acquisition of all types is most prevalent in New York, Massachusetts, New Jersey, and Florida. It is not as prevalent a technique in

South Carolina, Texas, and North Carolina. In all states, the acquisition of undeveloped land is the most frequently used of these measures. The average effectiveness of this approach is relatively high in all the states, except South Carolina, where only one locality reports its use. Acquisition of development rights and damaged buildings are considered to be of lower effectiveness. Building relocation programs present mixed results, with localities in Florida considering it to be of relatively high effectiveness and localities in New Jersey assigning it considerably lower scores.

Hazard disclosure requirements are used to a considerable extent in all seven states, with the highest percentage of use in Texas and the lowest in New Jersey. Construction practice seminars are used by a considerable percentage of the sample in South Carolina, Texas, Florida, and North Carolina. Considerably fewer localities are using this technique in Massachusetts, New York, and New Jersey. Most average effectiveness ratings for hazard disclosure are low relative to, say, the acquisition of undeveloped land. The localities in Florida, however, appear to consider this approach to be of significantly greater effectiveness than do localities in the other states. Average effectiveness ratings for construction practice seminars are relatively high, particularly for such states as New York and Florida.

IX. Forces Shaping Development in Coastal Communities

From the variables in this data set we can obtain insights into what factors influence development patterns in coastal localities where hazards are present. More specifically, two questions on the survey have been used as dependent variables, and their associations with a series of independent variables have been tested. The two dependent variables are: the percentage of a locality's floodplain which is developed (V4) and the percentage of the

total dollar value of development occurring in the flooplain in the last 5 years (V14). These two dependent variables are ordinal measures, and most of the following independent variables are dichotomous nominal. Consequently, either Tau-b or Lambda are used as measures of the strength of associations. In reporting measures of association we have established a cut-off point of $\pm$.15. In addition, because the survey information is population data and not sample data (see the first section of this paper) we have not reported significance levels. The strength of the association rather than its statistical significance is the important measure. It should be noted that while we report only relationships of at least $\pm$.15 in the text, all associations (associations with all independent variables) are reported in the appendix.

Table 35 presents the cross-tabulations among independent variables with associations above .15 and the dependent variable "percentage of the flooplain developed." Not surprisingly, a relatively strong positive association exists between the dependent variable and percentage of the jurisdiction lying in the 100-year coastal floodplain. This acknowledges the primary physical constraint to localities, i.e., those localities there a greater portion of their land area lies in the floodplain are more likely to have developed these areas; the physical/natural attributes of their jurisdiction appear to dictate, to some extent, this hazardous development. This is reinforced by the inability to find development sites outside of the hazard areas. The variable "abundance of sites outside of the coastal floodplain" is positively associated with the dependent variable suggesting that, as expected, the scarcer such sites are thought to be, the greater will be the percentage of a jurisdiction's floodplain which is developed. (Note that the scale runs from 1-very scarce to 5-very abundant.)

Table 35

Bivariate Associations, Dependent Variable:
Percent of Floodplain Developed (V4)

Independent Variables (.15 strength of association or greater)		Coefficient*
(V3)	Percent of jurisdiction land area in 100-year coastal floodplain	.264
(V15)	Abundance of residential sites outside 100-year coastal floodplain	-.194
V17)	Storm hazard reduction objectives: guiding new private development into areas less susceptible to storm hazards	-.274
(V18)	Storm hazard reduction objective: locating new public facilities and structures in areas less susceptible to storm hazards	-.272
(V136)	Regional agency involved in storm hazard mitigation	.148
(V156)	Agricultural economic base	-.311

*Kendall's Tau-b

Relatively strong associations are seen between the dependent variable and two objectives of storm hazard reduction strategies: 1) guiding new private development into areas less susceptible to storm hazards, and 2) locating new public facilities and structures in areas less susceptible to storm hazards. These are the two objectives, from a list of ten, that are perhaps most representative of the development management philosophy. The associations in both cases are negative, suggesting that where these objectives are part of a locality's program, there is less development in the jurisdiction's coastal floodplain.

Though falling slightly below the .15 criterion, the involvement of a regional agency is positively related to proportion of the floodplain. If a causal relationship exists between these two variables, it is likely that the latter influences the former, rather than the reverse. Hurricane evacuation planning is typically a major activity of such regional agencies, and it may be that in jurisdictions where the floodplain is highly developed the need for regional assistance in this area is greater.

The economic base of a locality will, of course, also strongly influence the use of hazard areas. An agricultural economic base was found to be associated with a low extent of floodplain development. This is logical given that such an economic base almost by definition leaves land undeveloped, and does not generate the development pressures that other uses such as manufacturing and commercial uses would.

The second dependent variable -- percentages of the total dollar development in a locality occurring in the floodplain in the last 5 years (V14) -- provides a similar measure of the extent of hazardous development patterns and their causal influences. Again, the percentage of the jurisdiction's land area lying in the floodplain is highly associated. As well, a scarcity of "safe" development sites is again related to greater floodplain development, and the two above development objectives are again associated with a lower level of floodplain development. This suggests that where such objectives exist, they are reasonably successful at keeping the floodplain undeveloped. As well, the objectives of strengthening public-private structures and public facilities and structures are positively associated with greater levels of floodplain development. This is a logical response: if strengthening structures is the policy approach adopted, location in the floodplain is less of a concern. Perhaps a more sensible interpretation is that existing or

current development of the floodplain dictates the type of mitigation strategy; if the floodplain is going to be developed, then strengthening buildings and facilities is the most appropriate course of action. The objective of conserving protective features of the natural environment is also positively associated with greater floodplain development. This suggests the importance of this approach in situations where significant development is occurring or has occurred in flood areas.

Several development management techniques are positively associated with the dependent variable. The most highly associated is the evacuation plan (.345). This is reasonable: the greater the extent of development occurring in high hazard areas, the greater the need for such a plan. It is unlikely in this case that the relationship runs in the other direction; i.e., because an evacuation plan exists, hazardous development should be allowed to take place. This explains as well the positive association with the storm hazard reduction objective of increasing evacuation. Among the other techniques positively associated are the following: recovery/reconstruction plan or policies; hurricane/storm component of comprehensive plan; dune protection and shoreline setback; and construction practice seminars. These techniques are consistent with increased development of the floodplain in the sense that they are all at least partially oriented to accommodating -- albeit safer -- development in the floodplain. As Table 36 indicates, the number of planning personnel is also positively related to this variable, which might be explained in a similar manner.

A variable which again becomes important is the presence of a regional agency involved in storm hazard management. Where such agencies exist, the percent of the total dollar value of new development occurring in the floodplain tends to be higher. Again this may be a reflection of an increased need

Table 36

Bivariate Associations, Dependent Variable: Percent of the Total Dollar Value of Development in a Community Occurring in Floodplain in Last 5 Years (V14)

Independent Variable (.15 strength or greater)		Coefficient*
V2	Priority given to coastal storm threat by governing body	-.245
V3	% of jurisdictions land in 100-year coastal floodplain	.591
V15	Abundance of residential sites outside the 100-year coastal floodplain	-.202
V17	Storm hazard reduction objective: guiding new private development into areas less susceptible to storm hazards	-.330
V18	Storm hazard reduction objective: locating new public facilities and structures in areas less susceptible to storm hazards	-.236
V21	Storm hazard reduction objective: increasing evacuation capacity	-.194
V23	Storm hazard reduction objective: increasing ability of private structures to withstand storm forces	.254
V24	Storm hazard reduction objective: increasing ability of public structures to withstand storm forces	.225
V26	Storm hazard reduction objective: conserving protective features of the natural environment	.162
V260	Hurricane component of comprehensive plan	.149
V262	Recovery/reconstruction plan or policies (planning)	.183
V263	Evacuation plan (planning)	.345
V266	Dune protection (development regulation)	.229
V267	Shoreline setback (development regulation)	.165
V279	Construction practice seminars	.175
V136	Regional agency involved in storm hazard mitigation	.222
V151	Economic base: tourism and recreation	.265
V154	Economic base: retirement community	.201
V197	Number planning personnel per capital	.179

*Kendall's Tau-b

for such a regional effort, especially given the fact that the preparation of evacuation and emergency plans (rather than development management in a strict sense) are common and predominant activities of these agencies (e.g., Tampa Bay Regional Planning Council 1981).

Two types of economic base are found to be positively associated with increased floodplain development: tourism/recreation and retirement. This is a logical finding, as in coastal localities these are the economic activities most likely be attracted to high hazard areas, e.g., hotels/motels, condominiums on the water.

X. Factors Influencing the Adoption of Development Management Measures

A. Obstacles to the Enactment of Development Management

An important question in this research is how politically feasible development management is likely to be in coastal localities. In an effort to better understand why such measures are more or less feasible, we asked respondents to identify factors and attributes of their local circumstances which serve as obstacles to the enactment of development management. This was accomplished by presenting respondents with a list and asking them to assess their relative importance.

Two types of data from this question can provide a sense of which obstacles are most important. First, is absolute number of respondents that Indicated that a particular group or factor was important in their locality. Table 37 presents these obstacles in order of frequency selected. General conservative attitudes toward government control of private property rights was the obstacle most frequently selected by respondents (selected by 89%). This was followed closely by general feelings that the community can "weather the storm" (87%), and lack of adequate financial resources to implement

Table 37

Obstacles to the Enactment of Development Management In Order of Frequency

Rank	Frequency	Percent	Importance Index*
1. General conservative attitude toward government control of private property rights (V96) N=359	319	88.9	3.38
2. General feeling that community can "weather the storm" (V95) N=357	309	86.6	3.09
3. Lack of adequate financial resources to implement mitigation programs (V97) N=347	296	85.3	3.41
4. More pressing local problems and concerns (V94) N=351	291	82.9	3.28
5. Opposition of real estate and development interests (V91) N=355	286	80.6	3.06
6. Lack of trained personnel to develop mitigation programs (V98) N=345	278	80.6	2.91
7. Lack of incentives or requirements from higher levels of government (V99) N=345	278	80.6	3.02
8. Opposition of homeowners (V92) N=338	252	74.6	2.64
9. Opposition of business interests (V90) N=337	241	71.5	2.60
10. Absence of politically-active individuals and groups advocating hurricane/storm mitigation (V93) N=339	242	71.4	2.85
11. Inadequate or inaccurate federal flood insurance maps (V100) N=342	215	62.9	2.49

*on a five-point scale.

mitigation programs. Ranked fourth according to frequency selected is the obstacle posed by more pressing local problems and concerns. Oppositon of real estate and development interests rounds out the top five responses.

A second measure is the relative importance assigned to the obstacle by the respondent, and an average importance score was calculated for each entry. The order of the most important obstacles remains largely the same when degree of importance is considered. The absence of political advocates for storm hazard mitigation moves into the top five, while the feeling that the locality can "weather the storm" drops out. Some reordering among the remaining four is also apparent. While lack of financial resources was rated fourth in terms of the frequency of responses, it moves to first when degree of importance is considered.

B. Arguments Against Enactment

To understand the nature of political opposition to development management programs it is important to fully understand the types of normative and other arguments typically made against the use of such techniques. Survey respondents were asked to evaluate a short list of common arguments and indicate which were important and the extent of their importance.

As can be seen in Table 38, the leading argument is that development management measures will lead to increased development costs. This is the clear leader both in terms of frequency of responses and perceived degree of importance. The traditiional argument that decisions about storm risks are best left to the individual is second in frequency and importance, followed by arguments about the effects on the local economy and the legality of development management programs. Despite this relative ranking, a major conclusion is that each of these arguments is quite important in a substantial number of the coastal localities in our population.

Table 38

Arguments Against Enactment of Development Management in Order of Frequency

Rank	Frequency	Percent	Average Importance*
1. Development management measures lead to increased developmental costs (V105) N=368	315	85.6	3.18
2. Decisions about risks from coastal storms are best left to the individual (V106) N=346	246	71.1	2.66
3. Development management measures dampen local economy (V104) N=355	245	69.0	2.52
4. Particular development management measures are illegal or unconstitutional (V107) N=338	225	66.6	2.42

*on a five-point scale.

C. Associations Among Key Variables

To provide a more indepth understanding of the factors and local attributes influencing the adoption and feasibility of development management measures, a number of independent variables were tested for their association with key dependent variables. More specifically, bivariate relationships were tested using two dependent variables: existence of an explicit storm hazard mitigation strategy (V16), and an index of the use of development management measures (V168).

Table 39 presents coefficients of association at or greater than .15 in strength, for the dependent variable "explicit storm hazard reduction strategies" (V16). Several independent variables are found to be associated with the dependent variable. Not surprisingly, the strongest coefficient is found for priority of the storm hazard threat to local governing bodies (V2).

Table 39
Bivariate Associations, Dependent Variable: Forces Influencing Adoption of Explicit Storm Hazard Mitigation Strategy (V16)

Independent Variables (.15 strength or greater)		Coefficient
(V2)	Priority given to coastal storm threat by governing body	-.294**
(V3)	% of jurisdiction's land area in 100-year coastal floodplain	.170**
(V7)	Types of new development in the floodplain in last 5 years: multi-family	.184*
(V8)	Types of new development in the floodplain in last 5 years: commercial	.149*
(V111)	Hit by severe coastal storms since 1970	.196*
(V118)	Familiarity with programs for state assistance	-.175*
(V136)	Involvement of regional agency in local storm hazard mitigation	.214*
(V153)	Economic base: service and trade	.181*
(V201)	Value of building permits issued in 1983 per capita	.140*

*Product moment correlation
**Kendall Tau-b

The greater this priority is, the more likely a coastal locality is to have an explicit storm hazard reduction strategy. (Note that the coefficient is negative because the scale on this variable runs from 1-high priority to 5-low priority). As well, such storm hazard strategies are positively associated with the percentage of the jurisdiction's land in the 100-year coastal floodplain (V3). Thus, the greater this percentage, the greater is the physical threat in a locality, and as would be expected, the greater is the propensity to adopt an explicit storm hazard strategy.

Not surprisingly, also, is a relatively high correlation coefficient for localities that have been hit by severe coastal storms since 1970 (V111). This is consistent with conventional thinking, and suggests that storm history, particularly when it is recent, is a positive influence on the adoption of mitigation measures (e.g., Tversky and Kahneman 1974).

Another positive influence is the value of building permits issued in a locality per capita (although falling somewhat below the .15 criterion). The greater their value, the more likely a locality is to have an explicit storm hazard reduction strategy. suggests that where development activity and growth in a locality are substantial, the likelihood of a storm hazard mitigation program is greater.

Two types of new development in the floodplain are associated with storm reduction strategies: multi-family and commercial uses. These uses may represent good proxies for the extent of development pressures occurring in a jurisdiction (e.g., condominiums, hotels) and can serve to increase the local salience and importance of storm hazard mitigation. This is further supported by the economic base variable of service and trade (V153) which is associated with storm hazard strategies. It should be remembered that the dependent

variable in this case (V16) could include structural and building code responses, as well as development management measures as we have defined them.

The effects of involvement of regional and state agencies in local mitigation efforts is an important question. The data indicate that there is a positive association between such an involvement (V136) and the adoption of explicit storm reduction strategies by localities. This suggests that the planning activities of these regional agencies may serve to effectively stimulate local mitigation efforts. There is also a positive relationship between the existence of an explicit storm hazard reduction strategy and familiarity with sources of state assistance for local hazard planning.

The second dependent variable was created by constructing an index of the number of development management measures used by individual coastal localities (V168). Thus, the assumption behind this index is that those localities employing a greater number of measures are generally those localities which are "doing more" development management. It could be, however, that a locality has but one or two primary development management measures, and is using these in strong and innovative ways. This index would by definition overlook this type of situation.

A number of independent variables satisfied the minimum .15 strength of association. Again, the priority given to the coastal storm threat was associated with the frequency of development management measures, as was new multi-family development in the floodplain (variable V2 and V7). Once again economic bases of service and trade (V153) proved important, as did the value of building permits issued in 1983 per capita (V201). In addition, localities with economic bases of tourism and recreation, and retirement communities, are more likely to adopt such measures (V151 and V154).

As with the previous dependent variable, adoption of development management programs is strongly associated with the involvement of regional agencies and familiarity with sources of state assistance. Indeed, the correlation coefficient is considerably greater in these cases indicating the particularly important role such agencies play in encouraging or even requiring mitigation planning, and provision of the necessary resources and expertise for this.

Permanent population in 1983 (V145) is also an important variable, with a positive relationship to the number of development management measures a locality has adopted. This is consistent with the literature and conventional reasoning that larger localities are better equipped to utilize development management, and are more likely to have a history of its use. The number of full-time planning staff per capita is also an additional indication of the institutional capacity and locality size (V197).

Several types of new development in the floodplain are positively associated with the adoption of development management techniques: multifamily, commercial and public recreational/park land. The first two categories represent intensive uses of the floodplain, and perhaps create a sense of urgency for controlling development within hazard areas. The latter uses perhaps represent the results of local development management programs.

Two additional independent variables satisfying the .15 criterion are a bit of a mystery. These have to do with obstacles to enactment indicated as being important in the respondent's locality. These are: 1) the opposition of business interests (V90) and 2) the opposition of real estate and development interests (V91). Both of these variables are positively associated with the development management index. Thus the importance of these obstacles increases with the number of development management measures

in use. What this suggests, perhaps, is that the development management programs -- and the process of their enactment -- serve to create or generate these obstacles. Of course, localities with high scores on the development management index may wish to do more than they are presently doing but may be constrained by these obstacles. Generally, presence of the obstacles to enactment (of high importance) listed in question 1 of the survey does not seem to explain why localities are low on the development management index.

Another variable which just barely falls below the .15 criterion is that of storm history (V111). As proposed earlier the fact that a hurricane or storm has occurred in the locality may do much to create the impetus and mandate for storm mitigation programs in general, including development management measures.

Table 40

Bivariate Associations, Dependent Variable: Index of Development Management Techniques (V168)

Independent Variables (.15 strength or greater)		Cofficient
(V2)	Priority given to coastal threat by governing body	-.239**
(V7)	Types of new development in floodplain in last 5 years: multi-family	.292*
(V8)	Types of new development in floodplain in last 5 commercial	.158*
(V10)	Types of new development in floodplain in last 5 years: public recreational/park land	.154*
(V90)	Obstacles to enactment: opposition of business interests	.162**
(V91)	Obstacles to enactment: opposition of real estate and development interests	.145**
(V111)	Hit by severe coastal storms since 1970	.142*
(V118)	Familiarity with state assistance	-.244**
(V136)	Involvement of regional agencies in local storm hazard mitigation	.262*
(V145)	Permanent population in 1983	.204*
(V151)	Economic base: tourism and recreation	.228**
(V153)	Economic base: service and trade	.149**
(V154)	Economic base: retirement community	.190**
(V197)	Number of full-time planning staff per capita	.277*
(V201)	Value of building permits issued in 1983 per capita	.314*

*Product Moment Correlation Coefficient
**Kendall's Tau-b

XI. Factors Influencing the Effectivenss of Development Management Measures

A. Enforcement and Implementation Problems

An important question in our research is the extent to which the programs and measures localities have in place are effective in reducing local storm hazards. Before analyzing associations between important variables, we will briefly discuss some of the more descriptive findings. Fifty percent of the respondents indicated that they had encountered problems enforcing or implementing the development management programs they had identified in Question 13. Responding to a more specific listing of problems, the following (in rank order) were identified as important:

Table 41

Problems in Enforcement and Implementation of Development Management Measures

Rank Order	Frequency	Percent
1. Insufficient funds (V74) N=195	116	59.5
2. Public opposition (V77) N=194	89	45.9
3. Lack of support by public officials (V78) N=192	83	43.2
4. Lack of qualified personnel (V75) N=195	79	40.5
5. Insufficient data base (V76) N=195	63	32.3

Opposition from developers and public apathy were also listed by several respondents.

Generally, we can conclude that a major portion of the responding localities have enforcement and implementation problems, and that overall, certain problems, such as insufficient funds and public opposition, are more important than others. Unfortunately this question does not permit the

respondent to indicate the severity of these problems, but only whether they exist or not. For instance, while insufficient funds may have been identified frequently as a problem, it may be a relatively small problem in each individual locality.

B. Undesirable Consequences of Development Management

Respondents were asked to consider whether the development management measures used in their jurisdiction (Question 12) have induced any undesirable consquences or side effects. Roughly two-thirds (66.7%) indicated that no such consequences had resulted. For the one-third of the respondents that answered in the affirmative, they were then asked to identify which consequences occurred, from a list provided in the questionnaire. The overwhelming consequence, selected by more than 80% of this group, was an increase in construction costs. The remaining entries ran a distant second, being selected by only 10% to 20% of the localities with such consequences. Again, however, this question does not take into consideration the severity of the consequences. While most localities may experience an increase in construction costs, in each locality this increase may actually be small.

Table 42

Undesirable Consequences Resulting From Development Management

Rank Order	Frequency	Percent
1. Increase in construction costs (V83) N=127	106	83.5
2. Slowed economic growth and development (V86) N=127	26	20.5
3. Reduced tax revenues (V85) N=127	19	15.0
4. Reduced land values (V84) N=127	14	11.0

C. Associations Among Key Variables

Bivariate associations were computed for two dependent variables from the questionnaire: 1) combined effectiveness of storm hazard mitigation programs (V72) and 2) an average effectiveness rating for all development management measures (V171).

As shown in Table 41, the priority given to the coastal storm threat by local governing bodies (V2) is seen to be associated with combined effectiveness, the first dependent variable (V72). (Note that the scale on the priority variable is reversed resulting in a positive association). This is logical, given that political will has much to do with the effective enforcement and implementation of measures, and indeed the enactment of the appropriate measures in the first place. The variable "lack of support by public officials," (V78) also appears to confirm this. Its relationship to combined effectiveness suggests that as the support of public officials wanes, combined effectiveness is reduced.

The existence of an explicit storm hazard reduction strategy (V16) is, not surprisingly, associated with greater combined effectiveness. (Note that the reverse scale for V16 causes a negative sign for its coefficient.) This may suggest several things. First, many local measures, such as zoning or dune protection, have multiple objectives, and they are more likely to be effective at reducing storm hazards if this is in fact one -- if not their primary -- intended objective. Second, even where such measures are intended to address local storm hazards they may tend to be more effective at this when integrated into an explicit overall storm hazard mitigation strategy.

Table 43

Bivariate Associations, Dependent Variable: Combined Effectiveness of Storm Hazard Mitigation Programs (V72)

Independent Variables (.15 strength or greater)		Coefficients*
(V2)	Priority given to the coastal storm threat by governing body	.199
(V16)	Have explicit storm hazard reduction strategy	-.180
(V78	Problems in enforcement and implementation: lack of support by public officials	.214
(V116)	Stronger measures adopted after the most recent storm	-.195
(V117)	Stronger measures adopted after the most severe storm	-.225

*Kendall's Tau-b

Two variables positively associated with combined effectiveness (again note the reversed scale) query localities as to whether they have adopted more stringent measures following a hurricane or severe storm. These are: 1) stronger measures adopted after the most recent storm (V116), and 2) stronger measures adopted after the most severe storm (V117). Thus those localities that had adopted more stringent measures following a storm are more likely to rate combined effectiveness as being higher. This may suggest that such post-storm measures are particularly suitable to reducing storm hazards. Moreover, it may suggest that these localities are generally more likely to have taken serious actions to address the storm hazard, and consequently have a higher combined effectiveness score.

The second dependent variable tested, was designed to evaluate the effects of a number of independent variables on the "average effectiveness" of the development management measures that respondents indicated were being

used (see Question 12). This variable (V171) was constructed by averaging for each respondent the effectiveness ratings given to those measures in use. Some of the findings from these associations are similar to those for the combined effectiveness variable. Priority given to this storm threat by local officials again appears to be important. The political priority or importance of this issue, not surprisingly, influences both the adoption of stronger and more effectual programs in the first place, as well as a more committed implementation and enforcement of these measures.

The existence of an explicit storm hazard strategy (V16) was again associated with effectiveness, in the case of development management measures. This is logical for the reasons cited earlier. Again, the adoption of stronger measures after the most recent and most severe storms (V116 and V117) is associated with effectiveness, although the variable dealing with adoption of measures following the most recent storm did not meet the .15 strength of association criterion.

Table 44

Bivariate Associations, Dependent Variable: Average Effectiveness Rating for DM Programs (V171)

Independent Variables (.15 strength or greater)		Coefficient
(V2)	Priority given to the coastal storm threat by governing body	-.203**
(V16)	Have explicit storm reduction strategy	.267*
(V76)	Insufficient data base	-.155
(V116)	Stronger measures adopted after most recent storm	.152*
(V117)	Stronger measures adopted after most severe storm	.190*
(V118)	Knowledge of sources of state assistance	-.205*

*Correlation Coefficient
**Kendall's Tau-b

Knowledge of sources of state assistance (V118) also proved important. This is consistent with earlier findings in this paper and may suggest that state involvement in hazard planning is quite important in enhancing the effectiveness of local programs. It may also indicate, of course, that those localities that have effective programs are naturally more likely to be knowledgeable about state assistance programs. A related variable -- an insufficient data base -- was found to be negatively related to average effectiveness, perhaps reinforcing the need for regional and state technical assistance.

XII. Adoption of Mitigation Measures Following a Storm

Respondents were asked on the questionnaire whether or not their locality had been hit by severe coastal storm since 1970 (defined as hurricane, tropical storm or northeaster which caused substantial property damage). Approximately two-thirds of the respondents answered this question in the affirmative (61.8%). If respondents answered yes to this question they were then asked to provide the name (if it had one) and date of the most severe and/or most damaging storm during this period.

More than a third of the respondents indicated that their localities had adopted more stringent development management measures following the occurrence of a storm. Approximately 33% of the respondents to this question adopted such measures following the most recent storm event, while 37% adopted such measures following the most damaging storm (32.9% and 37.2%, respectively). As might be expected, this percentage is somewhat higher in response to the more damaging storm. These findings suggest that storm events do significantly prompt development management innovation in coastal localities, and that this is more likely to occur in response to more severe events.

Additional support for these conclusions can be seen in the strength of associations between the storm history of a locality and its propensity to adopt development management measures and storm hazard reduction strategies and objectives. (See the earlier section of this paper dealing with factors influencing the adoption of development management measures.)

XIII. Summary and Conclusions

This report has provided an analysis of the results of a mail questionnaire sent to hurricane-prone localities (containing V-zones under the National Flood Insurance Program) in 18 Gulf and Atlantic coast states, plus Hawaii. A response rate of approximately 67% was achieved, yielding 403 useable responses. By definition these are communities which have a permanent population of at least 1000. Over 70% of the responding communities contained populations of less than 50,000. The questionnaires were typically answered by planning directors or planners (over 50%), although a substantial number were filled out by building officials, town managers, and planning board members.

The specific findings of the survey analysis and their implications for storm hazard policymaking, are numerous. The following represent brief highlights of the more interesting and important of these findings:

- In contrast to the findings of much of the past research on natural hazards, storm hazard mitigation is of relatively high priority to elected officials in the localities surveyed. Over 46% of respondents indicated it was of high or very high priority to the local governing body in relation to other local issues, and over 70% indicated that it was of at least medium priority.

• The predominant type of existing floodplain development in hurricane-prone survey localities is single-family detached residential. Assessments of new development indicates that a high degree of multifamily and commercial development (including commercial, recreational and hotel/motel) is occurring in coastal floodplains.

• In a significant number of the localities surveyed (about one-third), hazard-free development sites (sites outside of the 100-year floodplain) were considered to be either scarce or very scarce.

• More than half of the survey respondents (56%) did not know how long it would take to evacuate their localities should a hurricane threaten. About one-half of these respondents were located in jurisdictions of less than 20,000 in population.

• The majority of respondents were at least somewhat familiar with state programs assisting localities in storm hazard management. Most had received some type of state assistance in the past five years, with information on the National Flood Insurance Program, and floodplain maps being the most frequent types of assistance. One-half of the respondents also indicated that their locality had received assistance with disaster preparedness plans.

• In over half of the localities a regional agency had been involved in storm hazard mitigation. The most frequent type of involvement was the preparation of a regional evacuation plan.

• About one-half of the respondents (50.7%) indicated that their locality had adopted an explicit storm hazard reduction strategy, in addition to participation in the National Flood Insurance Program. The two most frequently selected objectives of this strategy (about 60% each) were

1) conserving the protective features of the natural environment and 2) increasing the ability of private structures and facilities to withstand storm forces. Guiding new private development into areas less susceptible to storm hazards was an objective in about 45% of the localities with an explicit storm hazard strategy.

• About two-thirds of the responding localities are currently using shoreline protection works (e.g., bulkheads, seawalls), while sand trapping structures (e.g., groins, jetties), sand moving programs (beach nourishment, sand scraping and flood control works (e.g., dikes, channels) are each in use in about one-third of the localities.

• Most localities have a building code in place, and have met the elevation and floodproofing requirements of NFIP (about 90% each). A little less than half of the respondents indicated that they had adopted special storm hazard resistant building standards (47%). Only about 15% of the localities had adopted more stringent elevation and floodproofing provisions than those required under NFIP.

• Most localities surveyed are using some type of development management. Approximately 70% indicated that they were currently using six or more of the 21 specific measures listed in the questionnaire. Roughly half of the localities fall in the 6 to 10 range (55%).

• Over eighty percent of the localities had enacted a comprehensive land use plan, and zoning and subdivision ordinances. From forty to sixty percent of the localities were using each of the following: a capital improvements program, an evacuation plan, a shoreline setback, dune protection regulations, a policy to locate public structures and buildings in less

hazardous locations, a policy to locate public facilities so as to discourage hazardous development, and the acquisition of undeveloped land in hazardous areas. Roughly 10 to 25% of the localities were using each of the following: a hurricane/storm component in the comprehensive plan, a recovery/reconstruction plan or policies, a special hazard area ordinance, below market taxation for open space, programs for the transfer of development potential from hazardous to non-hazardous parcels, the acquisition of development rights or scenic easements, hazard disclosure requirements in real estate transactions, and construction practice seminars for builders. Very few localities are currently using the following: impact taxes or special assessments, acquisition of damaged buildings in hazardous areas, and building relocation programs.

- Programs which strengthen buildings and facilities are generally perceived to be more effective in reducing local storm hazards than programs which structurally alter the coastal environment.

- The following ten development management measures were considered by respondents to be the most effective at reducing local storm hazards: special hazard area ordinances, impact taxes and special assessments, dune protection regulations, policies to locate public structures in safer locations, shoreline setback regulations, acquisition of undeveloped land in hazardous areas, evacuation plans, acquisition of damaged buildings in hazardous areas, programs which transfer development potential from hazardous to non-hazardous sites, and policies to locate capital facilities to reduce or discourage growth in hazardous areas. Several of the more conventional development management tools are considered to be less effective, including zoning and

subdivision regulations, comprehensive/land use plans, and capital improvements programs.

• Over 70% of the respondents believed their combined mitigation programs were either moderately effective or very effective.

• In ranking the importance of different mitigative approaches, development management measures were considered to be most important in the majority of localities, followed by programs to strengthen buildings and facilities, and programs to structurally reinforce the coastal environment, in that order.

• Through the use of bivariate analysis, the extent of the coastal floodplain developed appears to be positively influenced by, among other things, the extent of the locality's area lying in the floodplain and the scarcity of hazard-free development sites. Where an agricultural economy still exists, development in the floodplain is likely to be less substantial.

• From a list of eleven possible obstacles to the enactment of development management measures, the following were the four most frequently identified, with each chosen by over eighty percent of those responding to the question: 1) the general conservative attitude toward government control of private property rights, 2) a general feeling that the locality can "weather the storm," 3) lack of adequate financial resources, 4) the existence of more pressing local problems and concerns, and 5) the opposition of real estate and development interests. In addition, lack of trained personnel, lack of incentives or requirements from higher levels of government, opposition of homeowners and business interests, the absence of politically active individuals and groups advocating storm hazard mitigation, and inadequate or

inaccurate flood insurance maps, while not as frequently selected, were indicated to be of high importance as obstacles.

- A highly important argument against the enactment of development management identified by respondents is that such measures lead to increase development costs. Other arguments which were deemed important as well: that decisions about risks from coastal storms are best left to the individual, that development management measures will dampen the local economy, and that particular development management measures are illegal or unconstitutional.

- The adoption of an explicit storm hazard mitigation strategy is positively related to, among other things, the priority given to the storm hazard by the local governing body, the percentage of a locality's land in the coastal floodplain, and the intensity of new development occurring in these hazard areas.

- Past storm experiences, particularly those that are recent, are positively associated with the adoption of explicit storm hazard reduction strategies and development management measures.

- The quantity of new development occurring in a locality, as measured by per capita building permit data, is positively associated with the adoption of explicit hazard reduction strategies and development management measures.

- The population size of a locality, and its number of planning personnel per capita, are positively associated with the adoption of development management measures.

- An active role of regional agencies in storm hazard mitigation is positively associated with the adoption of explicit hazard reduction strategies and development management measures.

- One-half the respondents indicated that they had encountered problems in implementing or enforcing development management measures. Of these respondents, the most frequently identified type of problem was that of insufficient funds. Public opposition, lack of support by public officials, lack of qualified personnel, and an insufficient data base were also indicated as problems by a significant portion of the respondents.

- Approximately one-third of the respondents (33%) indicated that their localities had experienced negative consequences as a result of development management programs. The most frequent selection by an overwhelming margin was an increase in construction costs.

- The overall effectiveness of storm hazard mitigation programs, including development management, is positively associated with, among other things, the priority given to the storm threat, and negatively associated with a lack of support by public officials. As well, localities that have explicit storm hazard reduction strategies are more likely to have effective storm hazard management programs.

- Knowledge of sources of state assistance is positively associated with the effectiveness of development management measures.

- About 60% of the respondents indicated that their localities had experienced a hurricane or severe coastal storm since 1970. About one-third of the respondents in this group indicated that more stringent development management measures were adopted in response to these storms.

Appendix A

References

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Appendix B

Complete Listing of Coefficients for Bivariate Associations of Survey Variables

Table AP-1

Complete Bivariate Associations, Dependent Variable:
V4, Percent of 100-year Floodplain Developed

Independent Variable	Coefficients**	Independent Variable	Coefficients**
V2	-.032	V266	.075
V3	.264	V267	.042
V6	-.074	V268	.072
V15	-.194	V269	-.106
V16	.112	V270	-.061
V17	-.274	V271	-.056
V18	-.272	V272	-.009
V19	.001	V273	.027
V20	-.046	V274	-.017
V21	.083	V275	.088
V22	-.061	V276	.072
V23	.026	V277	.053
V24	.080	V278	-.001
V25	.133	V279	.056
V26	-.027	V69	-.116
V259	.029	V70	-.026
V260	.092	V71	.107
V261	.136	V72	.007
V262	.092	V73	.091
V263	.134	V111	.076
V264	.056	V118	-.028
V265	-.143	V136	.148